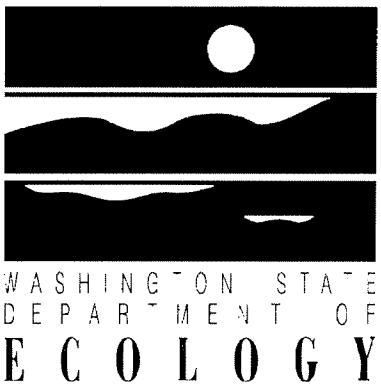

Eastsound Sewer and Water District
Orcas Village Wastewater Treatment Plant
Class II Inspection, October 1996

March 1997

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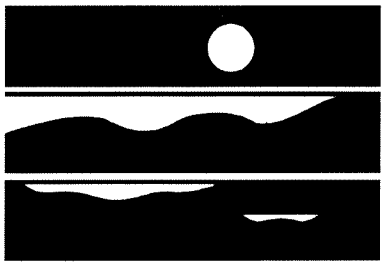

Eastsound Sewer and Water District
Orcas Village Wastewater Treatment Plant
Class II Inspection, October 1996

by
Steven Golding

Environmental Investigations and Laboratory Services Program
Olympia, Washington 98504-7710

March 1997

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Abstract

An announced Class II inspection was conducted at the Eastsound Sewer and Water District Orcas Village Wastewater Treatment Plant (Orcas Village WWTP) on October 21-23, 1996. The plant was producing a good quality effluent. The 24-hour effluent sample results were within limits in the Orcas Village National Pollutant Discharge Elimination System (NPDES) permit for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, and pH. One total residual chlorine measurement (0.6 mg/L) exceeded the permitted monthly average (0.5 mg/L) but was within the permitted weekly average (0.75 mg/L). Effective control of chlorine dosing is recommended.

Influent ammonia, nitrite-nitrate, and phosphorus concentrations were considerably higher than those associated with typical municipal wastewater influent, but the concentrations were typical for septic tank effluent. Septic tank effluent comprises the influent for the Orcas Village WWTP. Complete nitrification occurred through the plant, with all measurable ammonia converted to nitrite-nitrate.

Split samples showed good agreement for all BOD_5 analyses and for effluent TSS analyses. There was variability in influent TSS results between the Ecology and Eastsound laboratories and the cause was unclear. Hydraulic and organic loading to the plant were very low during the inspection. Influent BOD_5 and TSS loads were both below 4% of the monthly average design loading for the plant. The BOD_5 influent load during a 1990 Class II inspection was 60% of monthly average design load, but removal efficiencies were high during both inspections.

Two recirculation lines are designed to operate at equal flow rates. The plant's recirculation flow meters indicated that the flow in one line was more than ten times that of the other. Fouled flow sensors are suspected, but properly functioning meters are needed to evaluate actual flow through the lines. Regular maintenance of the flow sensors is recommended.

Summary

Flow Measurements

Flow measurements for the discharge and the two recirculation lines are made with in-line flow sensors not accessible for Ecology flow verification. One of the two recirculation meters showed low flow in the recirculation line it was monitoring. Because the recirculation pumps were operating for equal durations, it appears that the difference in recirculation flow measurements may be a result of flow sensor fouling, a recurrent problem at the plant. Adequate recirculation cannot be verified without proper flow sensor functioning.

The 1,324 gpd average flow during the inspection was lower than any of the monthly average flows recorded over a period of several years. The inspection took place midweek during the off-season, when visitations to Orcas Island are low and wastewater sources near the Orcas Island Ferry landing are contributing little sewage.

NPDES Permit Limits Comparison / General Chemistry

The treatment plant was performing well during the inspection. Influent and effluent data indicate effective removal of the conventional parameters BOD_5 (greater than 95% removal) and TSS (greater than 94% removal), higher than the 85% removal required by permit for both parameters. Low counts of fecal coliform in the effluent also indicate effective treatment. The 24-hour effluent sample results were within National Pollutant Discharge Elimination System (NPDES) permit limits for all parameters but one. One total residual chlorine measurement (0.6 mg/L) exceeded the permitted monthly average (0.5 mg/L) but was within the permitted weekly average (0.75 mg/L). It should be noted that the collection time for samples during this inspection was limited to a single 24-hour period, whereas some permit limits are based on monthly or weekly averages.

Influent ammonia, nitrite-nitrate, and phosphorus concentrations were considerably higher than those found in typical municipal wastewater influents, but they were within the range of typical septic tank effluent concentrations. The influent to the Orcas Village WWTP is comprised of septic tank effluent. A comparison of influent ammonia and nitrite-nitrate concentrations indicates that the WWTP was achieving complete nitrification at the time of the inspection.

Split Sample Results

Ecology and Eastsound Sewer and Water District laboratory analyses for BOD_5 were in close agreement. However, influent TSS results between the two laboratories varied by a factor of 2 or slightly more. Possible factors responsible for higher Orcas Village influent

TSS results include sample storage above 4° C or sample storage for long periods before analysis.

Ecology and Orcas Village composite and grab samples compared closely for all locations and parameters, showing agreement in sampling techniques.

Treatment Removal Efficiencies / Comparison with 1990 Data / Plant Operation

Effluent BOD_5 and TSS concentrations were low during both the 1996 and 1990 Environmental Investigations and Laboratory Services (EILS) inspections. They were lower in most cases than the detection limits for the tests. Percent removals for BOD_5 and TSS during both inspections were greater than 94%. Percent removals were somewhat higher in 1990 than in 1996. This may be a consequence of higher 1990 influent concentrations and all effluent concentrations approaching or falling below fixed detect limits for both inspections.

During both the 1996 and 1990 inspections, plant hydraulic and influent organic loadings were low. During the 1996 inspection, influent BOD_5 and TSS loads were both below 4% of the monthly average design loading for the plant.

In addition to the differences in flow rates and loadings during the 1996 and 1990 inspections, there was also a difference in plant operations. The recirculation pumps were found to be on 14 minutes of every hour during the 1996 inspection. In 1990 they had been on 5 minutes of every hour (Heffner, 1991). The increased circulation can be expected to improve treatment.

The plant's design engineer inspects the plant about every two months. The effluent flow sensor is cleaned with each visit but the recirculation flow sensors are cleaned only on occasion. A large disparity in measured recirculation flows between the two flow sensors (100 gpm; 8.4 gpm) was found during the 1996 inspection. When there is a low flow measurement for one of the recirculation lines, it is not possible to determine whether the low recirculation flow rate measurement indicates a malfunctioning flow sensor or an actual low recirculation flow. To provide for accurate recirculation flow measurements, the recirculation flow sensors should be inspected and cleaned regularly along with the effluent flow sensor.

Recommendations

- Chlorine dosing should be controlled to maintain a chlorine residual that is within permit limits and is also effective.
- The recirculation flow sensors should be inspected and cleaned regularly along with the effluent flow sensor.
- If recirculation flow is found to be inadequate after it is determined that the flow sensors are functioning properly, measures should be taken to restore adequate recirculation flow.
- A review of sample holding temperatures and procedures may provide for improvements in laboratory analysis results.
- The next inspection should be conducted during the summer season to evaluate plant performance under high loading conditions.

Introduction

An announced Class II inspection was conducted at the Eastsound Sewer and Water District Orcas Village Wastewater Treatment Plant (Orcas Village WWTP) on October 21-23, 1996. Conducting the inspection were Steven Golding and Guy Hoyle-Dodson of the Ecology Toxics Investigations Section. Robert Aggas, Operator, and Roy Light, Assistant Operator, assisted during the inspection.

The Orcas Village WWTP is a small facility (design capacity 15,000 gpd) serving development near the Orcas Island Ferry landing (Figure 1). The plant has operated since 1990. Effluent from septic tanks is pumped to the facility for treatment. The facility is regulated under NPDES Permit No. WA-003091-1. Discharge is into Harney Channel.

The facility consists of a recirculation basin where influent mixes with recirculated effluent (Figure 2). Recirculation basin contents are pumped to one of two gravel filters on an alternating basis. The pump cycle includes a short pumping period followed by a longer resting period for the filter. Effluent from the gravel filter goes to a modified float valve where it fills the recirculation basin to a set level. The float valve overflow is chlorinated, flows through the chlorine detention pipe, and is discharged through a diffuser that is located about two hundred feet from the shore in Harney Channel. The recirculation tank is power washed once per year and the resulting sludge is disposed of in a San Juan County landfill.

Objectives of the inspection included:

- Evaluate NPDES permit compliance
- Evaluate sampling and laboratory procedures with split samples
- Evaluate efficiency of wastewater treatment
- Compare results with those from the July 1990 EILS Class II inspection

Procedures

Composite and grab samples were collected by Ecology at influent (Inf-E; Inf-1; Inf-2), recirculation (Rcrc-E; Rcrc-1; Rcrc-2), and effluent (Eff-E; Eff-1; Eff-2; Eff-3; Eff-4) (Figure 2 and Table 1). Ecology conducted field measurements for all samples. Orcas Village collected composite samples of influent (Inf-E) and effluent (Eff-E) and grab samples of effluent.

A more detailed description of sampling procedures appears in Appendix A. Sampling station descriptions appear in Table 1. The sampling schedule, parameters analyzed, and sample splits are included in Appendix B. Ecology analytical methods and laboratories performing the analyses are summarized in Appendix C. Ecology field and laboratory QA/QC are summarized in Appendix D. Quality assurance cleaning procedures are included in Appendix E. A glossary appears in Appendix F.

Inspection Strategy

There is particular interest in the operation of the facility because the rock filter treatment system is one of the few in operation in the state. Samples of influent, effluent, and recirculation were taken to aid in characterization of treatment plant operation. Sampling was carried out in essentially the same manner as that of the July 1990 EILS Class II inspection (Heffner, 1991) so that comparisons could be made between results from the two inspections.

Because the facility serves a small area without significant industrial contributors, the potential for the presence of priority pollutant metals or priority pollutant organic compounds is not considered to be significant. Bioassay testing was also not considered necessary for this reason. Priority pollutant analyses or bioassay testing were not conducted during the 1990 inspection or the 1996 inspection. Instead, emphasis was placed on permit parameters and plant operation.

Dissolved oxygen (DO) measurements of recirculation and effluent were obtained in the 1990 inspection. DO concentrations were found to be high. DO measurements were not taken during the 1996 inspection because conditions were not critical, with lower organic loading and lower temperatures than those found during the 1990 inspection.

Results and Discussion

Flow Measurements

Flow measurements for the discharge and the two recirculation lines are made with the plant's in-line flow sensors. Since the meters were not accessible, flow measurements were not verified by Ecology.

Results from the pump meters showed that both recirculation pumps were in operation 14 minutes out of every hour. The recirculation rate during recirculation pump operation was measured to be 100 gpm (flow meter #1) and 8.4 gpm (flow meter #2). The plant is designed for recirculation flow rates to be equal through both recirculation lines. Since both recirculation pumps were of the same horsepower and were operating for equal time intervals, it is likely that the difference in the two recirculation line flow rates was a result of flow sensor fouling rather than an actual difference in recirculation rates. The recirculation flow sensors have been known to foul in the past, resulting in low flow readings (Light, 1997). Adequate recirculation cannot be verified, however, without proper flow sensor functioning.

The 1,324 gpd average effluent flow during the inspection was lower than any of the monthly average flows from 1991 through 1994 (Ecology, 1995) and is less than 9% of facility design capacity (weekly average basis). The inspection took place midweek during the off season, when visitations to Orcas Island are low and wastewater sources near the Orcas Island Ferry landing are contributing little sewage.

NPDES Permit Limits Comparison / General Chemistry

The treatment plant was performing well during the inspection. Influent and effluent data indicate effective removal of the conventional parameters BOD_5 (greater than 95% removal) and TSS (greater than 94% removal). These removal rates are higher than the 85% removal required by permit for both parameters. Low counts of fecal coliform in the effluent (160/100 mL or lower) also indicate effective treatment (Table 2). The 24-hour effluent sample met National Pollutant Discharge Elimination System (NPDES) permit limits for all parameters: 5-day biochemical oxygen demand (BOD_5); total suspended solids (TSS); total residual chlorine; fecal coliform; and pH (Table 3). One total residual chlorine measurement (0.6 mg/L) exceeded the permitted monthly average (0.5 mg/L) but was within the permitted weekly average (0.75 mg/L).

Chlorine dosage is flow-proportioned, but variability in the chlorine residual measured during the inspection (0.5 mg/L; 0.6 mg/L; 0.1 mg/L; <0.1 mg/L) indicates the need for more effective management of chlorine dosing. It should be noted that the collection time for samples during this inspection were limited to a single 24-hour period, whereas some permit limits are based on monthly or weekly averages.

Influent ammonia, nitrite-nitrate, and phosphorus concentrations were considerably higher than those found in typical municipal wastewater influents (Metcalf and Eddy, 1991). The concentrations appear to be typical of septic tank effluents, however. A study, based on 20 other studies, found septic tank effluent to contain an average of 62 +/- 21 mg/L nitrogen (Kaplan, 1991). Total phosphorus in septage is found in a range of concentrations similar to that of ammonia. Effluent from septic tanks may also be expected to have phosphorus concentrations in a range similar to that of nitrogen concentrations. This is in accord with the consistently high influent nitrogen and phosphorus data for Orcas Village (Table 2).

A comparison of influent ammonia and nitrite-nitrate concentrations indicates that the WWTP was achieving complete nitrification at the time of the inspection (Table 2). Ammonia concentration was reduced from 34 mg/L NH_3-N in the influent to less than 0.01 mg/L in the effluent. $NO_2 + NO_3$ -N correspondingly increased from 22 mg/L to 67 mg/l. In the effluent, there was surplus alkalinity (64.6 mg/L as $CaCO_3$) for nitrification.

Split Sample Results

Samples were split to determine the comparability of Ecology and permittee laboratory results and sampling methods (Table 4). Orcas Village laboratory analyses are conducted at the Eastsound Sewer and Water District laboratory. Ecology and Eastsound laboratory analyses for BOD_5 varied 31% (relative percent difference) for influent and were within 3 mg/L for effluent. Ecology and Eastsound TSS effluent analyses results were within 4 mg/L. However, influent TSS results between the two laboratories varied by a factor of 2 or slightly more.

Since the comparison in influent TSS results between the two laboratories is limited to two pairs of data points, the differences in results may not be significant. However, since Ecology TSS results were consistently lower than Eastsound results for both influent samples, both laboratories were asked to check their calculations. Both labs reported that no inconsistencies or errors were found (Jensen, 1997; Light, 1997). The Eastsound Sewer and Water District lab has produced acceptable results in analyzing control standards for TSS (Brake, 1997).

Possible factors responsible for higher Orcas Village influent TSS results include sample storage above 4° C or sample storage for long periods before analysis. Such sample storage conditions can allow for growth of microbes utilizing dissolved BOD, increasing the TSS of the sample. In support of this, Orcas Village influent BOD_5 analyses resulted in lower concentrations than did Ecology analyses.

Ecology and Orcas Village composite and grab samples compared closely for all locations and parameters, showing agreement in sampling technique (Table 4).

Treatment Removal Efficiencies / Comparison with 1990 Data / Plant Operation

Influent and effluent parameters as well as treatment removal efficiencies for the 1996 and 1990 EILS Class II Inspections are shown in Table 5. Removal efficiencies were calculated from comparisons of influent and effluent samples. The samples were composited for 24 hours for each of the two inspections.

Effluent BOD_5 and TSS concentrations were low during both the 1996 and 1990 inspections, lower in most cases than the detection limits for the tests. Percent removals for BOD_5 and TSS during both inspections were greater than 94%, with higher removal efficiencies in 1990 than in 1996. This may be a consequence of higher 1990 influent concentrations and all effluent concentrations approaching or falling below fixed detect limits for both inspections.

The percent removals were high despite the low influent concentrations of BOD_5 (86 mg/L) and TSS (16 mg/L) as compared with a typical influent strength of 220 mg/L for both parameters (Metcalf and Eddy, 1991). Septic tank effluent is the source of the plant's influent, accounting for its weakness. Since removal of BOD_5 and TSS take place in the septic tanks before entering the sewage system, percent removal as calculated from the plant tends to be lower than the overall percent removals would be if they could be calculated from the raw influent to the septic tanks. For this reason, direct comparisons cannot be made between removal efficiencies from the Orcas Village WWTP and other WWTPs treating raw municipal wastewater.

During both the 1996 and 1990 inspections, plant hydraulic and influent organic loadings were low, indicating that the plant was underloaded. During the 1996 inspection, influent BOD_5 and TSS loads were both below 4% of the monthly average design loading for the plant (Ecology, 1995). During the 1990 inspection, the influent BOD_5 load was 60% of the monthly average design BOD_5 loading and the TSS load was 6% of the monthly average design TSS loading. All effluent loadings for the inspections of both years were well below permitted effluent loadings.

In addition to the differences in flow rates and loadings during the 1996 and 1990 inspections, there was also a difference in plant operations. The recirculation pumps were found to be on 14 minutes of every hour during the 1996 inspection. In 1990 they had been on 5 minutes of every hour (Heffner, 1991). The increased circulation can be expected to improve treatment.

The plant's design engineer inspects the plant about every two months, making adjustments, such as to the recirculation cycle, and cleaning the effluent flow sensor. The recirculation flow sensors are cleaned less often (Light, 1997). A large disparity in measured recirculation flows between the two flow sensors (100 gpm; 8.4 gpm) was found during the 1996 inspection. Although the recirculation flow sensors have been known to foul, causing low flow readings, it is not possible to determine whether the low

recirculation flow rate measurement indicates a malfunctioning flow sensor or an actual low recirculation flow. It is important to be able to verify proper recirculation rates. At times when the plant receives higher loads, treatment effectiveness may be compromised if recirculation is impaired. To provide for verification of adequate recirculation flows, the recirculation flow sensors should be inspected and cleaned regularly along with the effluent flow sensor. If recirculation flow is found to be inadequate after it is determined that the flow sensors are functioning properly, measures should be taken to restore adequate recirculation flow.

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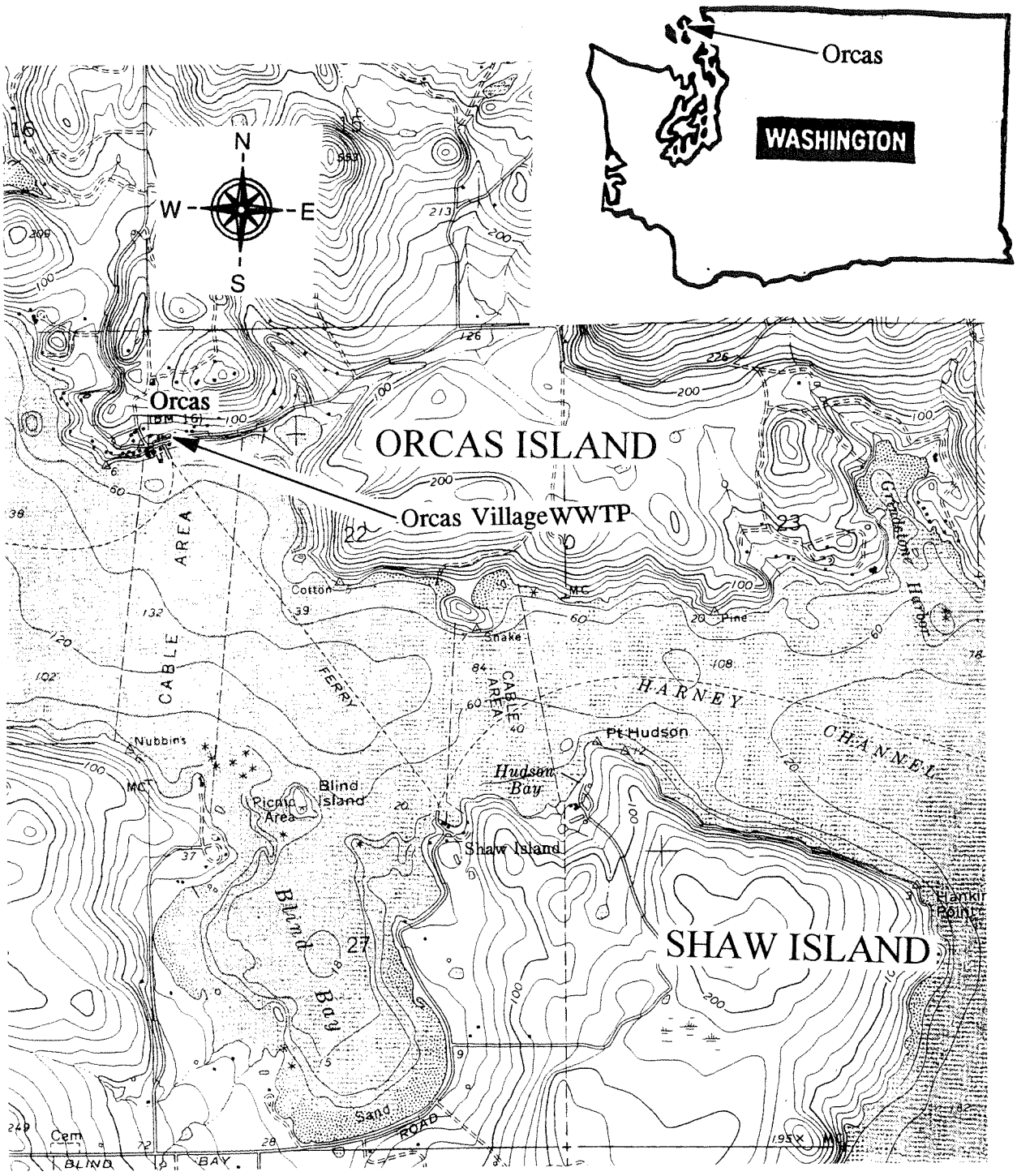

Figure 1 - Location Map - Orcas Village, October 1996.

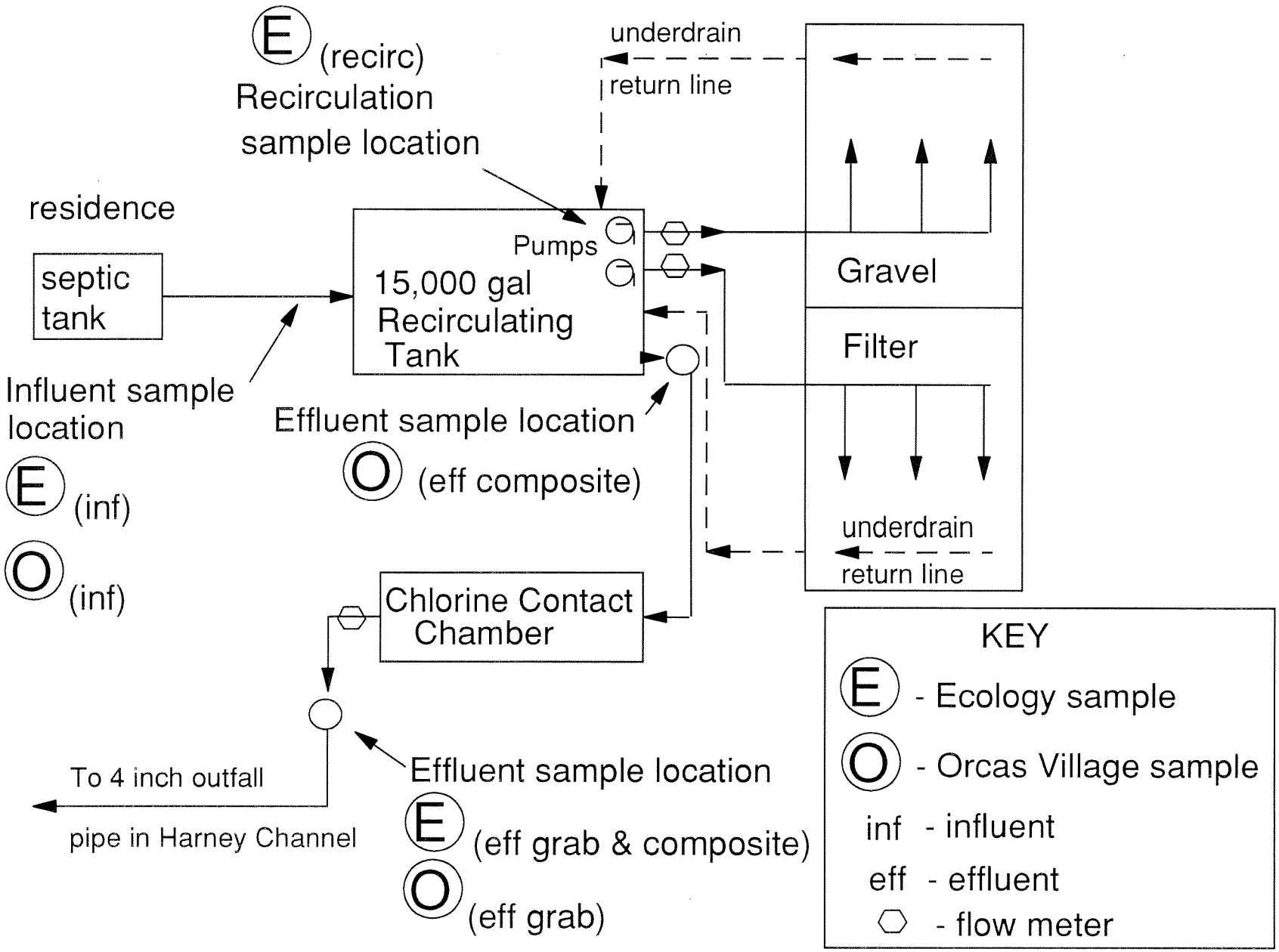

Figure 2 - Flow Schematic - Orcas Village, October 1996.

Table 1 - Sampling Station Descriptions - Orcas Village, October 1996.

Ecology influent grab and composite samples (Inf-1,2; Inf-E)

The composite influent sample was collected by lowering a strainer attached to a sampling line through a 2-inch PVC riser pipe. The strainer was placed 4 inches above the bottom of the influent pipe. Grab samples were obtained by pumping sample through the compositor.

Orcas Village influent composite samples (Inf-O)

Orcas Village collected their influent sample in the same manner as the Ecology influent samples described above.

Ecology recirculation grab and composite samples (Rcrc-1,2; Rcrc-E)

The composite recirculation sample was collected by lowering a strainer attached to a sampling line into the recirculation tank, one foot above the bottom of the tank. Flow from the gravel filter enters the recirculation tank near this location. Grab samples were taken from the recirculation tank directly.

Ecology effluent grab and composite samples (Eff-1,2,3,4; Eff-E)

The composite effluent sample was collected out of an effluent box downstream of the chlorine contact chamber. A strainer attached to a sampling line was placed one foot below the surface of the effluent. Effluent remained in the effluent box whether or not a discharge was occurring so that some composite subsamples were collected during periods of no discharge. Grab samples were taken from the effluent box directly.

Orcas Village effluent grab and composite samples (Eff-O)

The composite effluent sample was collected from an effluent box just downstream of the recirculation tank, upstream of the chlorine contact chamber. Effluent also remained in this effluent box so that some subsamples were collected during periods when there was no discharge. Grab samples were taken from the effluent box downstream of the chlorine contact chamber, the location of all Ecology effluent sampling.

Table 2 - General Chemistry Results - Orcas Village, October 1996.

Location:	Inf-1	Inf-2	Inf-E	Inf-O	Rcrc-1	Rcrc-2	Rcrc-E	Eff-1	Eff-2	Eff-3	Eff-4	Eff-E	Eff-O
Type:	grab	grab	comp	comp	grab	grab	comp	grab	grab	grab	grab	comp	comp
Date:	10/22	10/22	10/22-23	10/22-23	10/22	10/22	10/22-23	10/22	10/22	10/23	10/23	10/22-23	10/22-23
Time:	0940	1545	0845-0845	0915-0915	0935	1555	0845-0845	0945	1610	0915	1020	0845-0845	0915-0915
Lab Log #:	438180	438181	438182	438183	438184	438185	438186	438187	438188	438190	438191	438189	438192
GENERAL CHEMISTRY													
Conductivity (umhos/cm)	1240	1370	1120	1090	1010	1010	1030	1010	1020			1020	1020
Alkalinity (mg/L CaCO3)			352	346			96.6					64.6	61.8
TS (mg/L)			631	616			751					882	795
TNVS (mg/L)			388	385			399					423	451
TSS (mg/L)	26	20	16	19	3	2	3	2	1 U	1 U	1 U	1 U	1 U
TNVSS (mg/L)			2	2			1 U					1 U	1 U
BOD5 (mg/L)			86	72			12					4 U	4 U
BOD INH (mg/L)			63									4 U	
TOC (water - mg/L)	61.7	63.1	52.0	45.6				6.6	6.8			6.6	6.8
Total Kjeldahl Nitrogen (TKN) (mg/L)			34.5				2.11					1.0 U	
NH3-N (mg/L)	43	98	34	29	2.36	3.06	5.59	0.010 U	0.010 U			0.010 U	0.780
NO2+NO3-N (mg/L)	22	34	22	17	70	71	66	63	72			67	58
Total-P (mg/L)	21	18	20	14	19	11	16	17	18			13	9.2
F-Coliform MF (#/100mL)										1 U	160		
FIELD OBSERVATIONS													
Temperature (C)	12.7	14.6			13.4	13.7		13.4	13.8	12.5	13.2		
Temp-cooled (C)			2.8	7.5			3.7					3.2	7.2
pH	7.0	7.5	7.2	7.1	6.7	6.9	6.8	6.6	7.0	6.4	6.5	6.7	6.7
Conductivity (umhos/cm)	1380	1397	1227	1107	1078	1059	1095	1073	1084	1090	1079	1130	1087
Chlorine (mg/L)													
Free								<0.1	<0.1	<0.1	<0.1		
Total								0.5	0.6	0.1	<0.1		

Inf - influent sample
Rcrc - recirculation sample
Eff- effluent sample

E - Ecology sample
O - Orcas Village sample

grab- grab sample
comp - composite sample

U - The analyte was not detected at or above the reported result.

Table 3 - NPDES Permit Limits and Inspection Results - Orcas Village, October, 1996.

	NPDES Limits		Inspection Results	
Parameter	Monthly Average	Weekly Average	Composite Samples	Grab Samples
BOD5	30 mg/L 3.8 lbs/day 85% removal	45 mg/L 5.6 lbs/day	<4 mg/L <0.04 lbs/day* >95% removal	
TSS	30 mg/L 3.8 lbs/day 85% removal	45 mg/L 5.6 lbs/day	<1 mg/L <0.01 lbs/day* >94% removal	
Total Residual Chlorine	0.5 mg/L 0.06 lb/day	0.75 mg/L 0.09 lb/day		0.5; 0.6; 0.1; <0.1 mg/L <0.007 lb/day
Fecal Coliform	200/100 mL	400/100 mL		<1/100 mL; 160/100 mL
pH	6.0 to 9.0 (continuous)			6.6; 7.0; 6.4; 6.5
Flow	--	--	1,324 gpd**	

* Calculated from flow derived from effluent totalizer reading from 0918 on 10-22-96 to 0841 on 10-23-96.

** effluent totalizer reading from 0918 on 10-22-96 to 0841 on 10-23-96.

Table 4 - Split Sample Results Comparison - Orcas Village, October 1996.

	Location:	Inf-E	Inf-O	Eff-E	Eff-O
	Type:	comp	comp	comp	comp
	Date:	10/22-23	10/22-23	10/22-23	10/22-23
	Time:	0845-0845	0915-0915	0845-0845	0915-0915
	Lab Log:	438182	438183	438189	438192
	Sample by:	Ecology	Orcas	Ecology	Orcas
Parameter	Analysis by:				
TSS (mg/L)					
	Ecology	16	19	<1	<1
	Orcas	36	38	4	2
BOD5 (mg/L)					
	Ecology	86	72	<4	<4
	Orcas	63	63	1	1

Location:	Eff-3	Eff
Type:	grab	grab
Date:	10/23	10/23
Time:	0915	0900
Sampling and Analysis by:	Ecology	Orcas
Parameter		
Fecal Coliform (mg/L)	<1	4 est.
Total Chlorine (mg/L)	0.1	0.15
pH (std. units)	6.4	6.8

Inf - influent sample
Eff - effluent sample

E - Ecology sample
O - Orcas Village sample
comp - composite sample
grab - grab sample

Table 5 - Treatment Parameters and Removal Efficiency - Orcas Village, October 1996.

October 1996 Class II Inspection

Parameter		Influent	Effluent	% Removal
BOD_5	(mg/L)	86	<4	>95%
	(lbs/day)	0.95	<0.044	
TSS	(mg/L)	16	<1	>94%
	(lbs/day)	0.18	<0.011	
Flow	(gpd)		1,324	

July 1990 Class II Inspection

Parameter		Influent	Effluent	% Removal
BOD_5	(mg/L)	304	<5	>98%
	(lbs/day)	15.0	<0.24	
TSS	(mg/L)	24	1	96%
	(lbs/day)	1.18	0.049	
Flow	(gpd)		5,912	

Appendices

Appendix A - Sampling Procedures - Orcas Village, October 1996.

Ecology Isco composite samplers were set up to collect equal volumes of sample every 30 minutes for 24 hours. The samples were then divided into subsamples for analysis. The compositors were iced to preserve samples.

Orcas Village composite samplers were set up to collect equal volumes of sample every 30 minutes for 24 hours. The samples were refrigerated as they were collected.

Ecology influent and effluent composite samples and Orcas Village influent and effluent composite samples were split for both Ecology and Orcas Village (Eastsound Sewer and Water District) laboratory analysis. Sampler configurations and locations are summarized in Figure 2 and Table 1.

Appendix B - Sampling Schedule - Orcas Village, October 1996.

Location:	Inf-1	Inf-2	Inf-E	Inf-O	Rcrc-1	Rcrc-2	Rcrc-E	Eff-1	Eff-2	Eff-3	Eff-4	Eff-E	Eff-O
Type:	grab	grab	comp	comp	grab	grab	comp	grab	grab	grab	grab	comp	comp
Date:	10/22	10/22	10/22-23	10/22-23	10/22	10/22	10/22-23	10/22	10/22	10/23	10/23	10/22-23	10/22-23
Time:	0940	1545	0845-0845	0915-0915	0935	1555	0845-0845	0945	1610	0915	1020	0845-0845	0915-0915
Lab Log #:	438180	438181	438182	438183	438184	438185	438186	438187	438188	438190	438191	438189	438192
GENERAL CHEMISTRY													
Conductivity (umhos/cm)	E	E	E	E	E	E	E	E	E			E	E
Alkalinity (mg/L CaCO3)			E	E			E					E	E
TS (mg/L)			E	E			E					E	E
TNVS (mg/L)			E	E			E					E	E
TSS (mg/L)	E	E	EO	EO	E	E	E	E	E	E	E	EO	EO
TNVSS (mg/L)			E	E			E					E	E
BOD5 (mg/L)			EO	EO			E					EO	EO
BOD INH (mg/L)			E									E	
TOC (water - mg/L)	E	E	E	E				E	E			E	E
Total Kjeldahl Nitrogen (TKN) (mg/L)			E				E					E	
NH3-N (mg/L)	E	E	E	E	E	E	E	E	E			E	E
NO2 + NO3-N (mg/L)	E	E	E	E	E	E	E	E	E			E	E
Total P (mg/L)	E	E	E	E	E	E	E	E	E			E	E
F-Coliform MF (#/100mL)										E	E		
FIELD OBSERVATIONS													
Temperature (C)	E	E			E	E		E	E	E	E		
Temp-cooled (C)			E	E			E					E	E
pH	E	E	E	E	E	E	E	E	E	E	E	E	E
Conductivity (umhos/cm)	E	E	E	E	E	E	E	E	E	E	E	E	E
Chlorine (mg/L)													
Free								E	E	E	E		
Total								E	E	E	E		

Inf - influent sample
Rcrc - recirculation sample
Eff- effluent sample

- E - Ecology sample
- O - Orcas Village sample
- E - Ecology lab analysis
- O - Orcas Village (Eastsound) lab analysis

grab- grab sample
comp - composite sample

Appendix C - Ecology Analytical Methods - Orcas Village, October 1996.

Laboratory Analysis	Method Used for Ecology Analysis	Laboratory Performing Analysis
Conductivity	EPA, Revised 1983: 120.1	Manchester Laboratory
Alkalinity	EPA, Revised 1983: 310.1	Manchester Laboratory
TS	EPA, Revised 1983: 130.2	Manchester Laboratory
TNVS	EPA, Revised 1983: 160.3	Manchester Laboratory
TSS	EPA, Revised 1983: 160.2	Manchester Laboratory
TNVSS	EPA, Revised 1983: 160.2	Manchester Laboratory
BOD5	EPA, Revised 1983: 405.1	Manchester Laboratory
TOC	EPA, Revised 1983: 415.1	Manchester Laboratory
NH3	EPA, Revised 1983: 350.1	Manchester Laboratory
TKN	EPA, Revised 1983: 351.3	Manchester Laboratory
NH3	EPA, Revised 1983: 350.1	Manchester Laboratory
NO2 + NO3	EPA, Revised 1983: 353.2	Manchester Laboratory
Total P	EPA, Revised 1983: 365.3	Manchester Laboratory
F-Coliform MF	APHA, 1992: 9222D.	Manchester Laboratory

METHOD BIBILIOGRAPHY

APHA-AWWA-WPCF, 1992. Standard Methods for the Examination of Water and Wastewater, 18th Edition.

EPA, Revised 1983. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (Revised March, 1983).

Appendix D - Quality Assurance/Quality Control (QA/QC) - Orcas Village, October 1996.

SAMPLING QA/QC

Ecology quality assurance procedures for sampling included cleaning the sampling equipment for conventional pollutant sampling prior to the inspection to prevent sample contamination (Appendix E). Chain-of-custody procedures were followed to assure the security of the samples (Ecology, 1994).

LABORATORY QA/QC

All analyses requested were evaluated using USEPA Contract Laboratory Program (CLP) quality assurance requirements. The samples were received by the Manchester Laboratory on October 24, 1996 in good condition. Analysis of all parameters was performed within all applicable EPA holding times.

All initial and continuing calibration verification standards were within the relevant USEPA (CLP) control limits. A correlation coefficient of 0.995 or greater was met as stated in CLP calibration requirements. All procedural blanks were within acceptable limits. Duplicate analyses of all parameters were within acceptable limits. All laboratory controls were within acceptable limits.

Other quality assurance measures and issues

All nutrient samples with a "U" qualifier had a result less than the detection limit of 0.010 mg/L with the exception of TKN which have a detection limit of 1.0 mg/L.

All fecal coliform samples with a "U" qualifier had a result less than the detection limit of 1 mg/L.

All TSS and TNVSS samples with a "U" qualifier had a result less than the detection limit of 1 mg/L.

All BOD samples with a "U" qualifier had a result less than the detection limit of 4 mg/L.

TOC data

All TOC analyses were performed within applicable EPA holding times. All procedural blanks were within acceptable limits.

One of the three continuing calibration verification standards analyzed on 11-14-96 was not within the relevant EPA control limits, therefore, the data has been flagged as estimates. The total inorganic carbon (TIC) continuing calibration verification standard analyzed on 11-15-96 was not within the relevant EPA control limits. Since total organic

carbon (TOC) is calculated as total carbon (TC) minus total inorganic carbon (TIC), all TOC data could have been slightly affected. A correlation of 0.995 or greater was met as stated in CLP calibration requirements.

LABORATORY AUDIT

The Eastsound Sewer and Water District laboratory at the Eastsound WWTP received laboratory accreditation on October 27, 1994. The accreditation was most recently renewed effective October 27, 1996. The current accreditation is scheduled to expire on October 26, 1997.

Appendix E - Conventional Pollutant Cleaning Procedures - Orcas Village, October 1996.

CLEANING PROCEDURES FOR CONVENTIONAL POLLUTANT SAMPLING

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse three (3) times with distilled/deionized water
4. Allow to dry and seal with aluminum foil

Appendix F - Glossary of Terms - Orcas Village, October 1996.

BOD_5 - five day biochemical oxygen demand
comp - composite sample
E - Department of Ecology
Eff - effluent
EPA - United States Environmental Protection Agency
F-coli - fecal coliform bacteria
g - gram
gpm - gallons per minute
grab - grab sample
Inf - influent
MF - membrane filter
mg - milligram
mg/L - milligram per liter
NPDES - National Pollutant Discharge Elimination System
O - Orcas Village
pH - $-\log_{10}$ (hydrogen ion concentration)
QA - quality assurance
QC - quality control
Rcrc - recirculation
TC - total carbon
TIC - total inorganic carbon
TNVS - total nonvolatile solids
TNVSS - total nonvolatile suspended solids
TOC - total organic carbon
TS - total solids
TSS - total suspended solids
"U" or "<" - The analyte was not detected at or above the reported result; or less than
WWTP - wastewater treatment plant